

Hard truths: how our need for cement is putting the planet at risk; Scientists and industry are seeking alternatives to reduce product's heavy carbon footprint

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Body

David Stringer, who is leading a battle against a major cement operation that wants to set up shop in his eastern Ontario community, sees the irony in his role.

Stringer, 81, a structural engineer by profession, is president of the Vankleek Hill and District Nature Society, a citizens group that has joined forces with three environmental organizations in a bitter fight to prevent a major Canadian cement company from opening a plant on 56 hectares near L'Original, a quiet Ontario village nestled between Ottawa and Montreal.

Colacem Canada, owned by Quebec-based Beton Provincial Inc., says the plant would produce 3,000 tonnes of clinker - the main ingredient in cement and the most greenhouse-gas-intensive component of cement manufacturing - each day. The company estimates it would produce 1.16 million tonnes of cement per year, operating around the clock seven days a week.

Stringer's group and the others are trying to block this from happening. Of major concern, says Stringer, is global warming.

"These plants pump a huge amount of CO2 into the atmosphere," he says.

For Stringer, the irony lies in the fact that he works as an engineer for New York City construction projects - which depend heavily on cement and its end product, concrete.

"Concrete is indispensable. There's no question about that," says Stringer, who lives near the Colacem site.

In many ways, he exemplifies our relationship with concrete, the second most consumed product in the world, after water.

We depend on it - but it's harming our planet.

The London-based Chatham House think tank and the International Energy Agency say more than four billion tonnes of cement produced worldwide each year are responsible for about eight per cent of global carbon dioxide emissions.

By comparison, iron and steel account for four to seven per cent of CO2 emissions, according to the European Commission. The burning of fossil fuels such as coal, oil and gas is responsible for the most CO2, over 80 per cent.

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The energy to produce a tonne of cement is about 0.28 kilocalories per kilogram and one tonne of cement releases about 0.8 tonnes of CO2.

Colacem, which declined to comment for this story, says in its own documents that the plant would emit other pollutants, including nitrogen oxide. The company says, however, that these emissions would fall within provincial limits.

Stringer, leader of the Vankleek Hill group, counters that the Canadian Council of Ministers of the Environment, composed of environment ministers representing the provincial, federal and territorial governments, is proposing much stricter limits for nitrogen oxide. The proposed Colacem plant's levels would far exceed the council's proposed limits, Stringer argues.

The conversation happening around the world is not about getting rid of concrete. That's not going to happen. Rather, scientists, government leaders and the industry are trying to figure out the best ways to reduce cement's greenhouse gas emissions.

Cement and concrete are everywhere. Think skyscrapers, roads and bridges around the world. Or locally, as in the Eglinton Crosstown Line, footpaths on Toronto's waterfront, Pearson International Airport, the Rogers Centre, local churches, single-family homes.

Visualize the booming growth and the pressures on infrastructure in urban areas of China, India and African countries where millions of people are flocking from the countryside to teeming cities in search of homes and jobs.

Or cities like Toronto, Montreal, Ottawa and Vancouver, where tall condo buildings and commercial towers are seemingly springing up daily amid record housing shortages. Heading into 2019, the RLB Crane index, which tracks the number of operating tower cranes in 13 North American cities, noted Toronto's crane activity was up, with more than 400 highrise buildings planned for development.

Canada's production of Portland cement - the most commonly used form - is approximately 13 million tonnes a year, according to the latest figures from Statistics Canada.

The Canadian cement industry contributes about 1.5 per cent of Canada's total 716 megatonnes of CO2.

The World Cement Association, the U.K.-based body representing cement operations in 18 countries, said in its 2018 climate action plan that "like every energy and CO2-intensive sector, the global cement industry is at a crossroads." It will be necessary for the cement sector to adopt "faster implementation of greenhouse gas mitigation road maps, working closely with public authorities to shape regulation that enables a smooth transition towards a low carbon construction sector; or we could soon face more aggressive moves (to implement those changes) from investors, regulators and other stakeholders."

About 60 per cent of CO2 emissions from the cement industry comes from burning limestone, a key ingredient. The limestone is heated in a kiln to 1,500 or 1,600 C, a process that releases CO2 in the limestone. Carbon dioxide is also emitted from the burning of fuels to heat the kiln. The cement industry uses coal as its predominant fuel, though the industry is increasingly turning to waste and alternative fuels, including biomass, which is animal or plant material used to produce energy.

Once the limestone cools, you're left with clinker, a stony residue that is then ground and mixed with mineral additives to create cement - a lightweight, powdery product that is easy to ship all over the world.

Concrete, which is seven to 10 per cent cement, is made when you add sand, water and gravel to cement powder. A reactive process causes the mix to harden into a stone-like product.

There are 15 operating cement plants in Canada, including one in Leaside, and more than 1,000 concrete plants across the country.

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All of it - quarrying the limestone, burning it in a kiln, greenhouse gas emissions, the tonnes of sand and water, the delivery in thousands of heavy trucks - leaves a very large footprint on the environment and a demand for change and innovation.

To support the 2015 Paris Agreement target to limit global warming by 2100 to well below two degrees above pre-industrial levels, the World Cement Association encourages members to "develop ambitious climate protection strategies, action plans and targets." It adds: "Further innovation efforts are required both in processes and in products" while standards and building codes have to be introduced to "trigger a faster deployment of innovative solutions."

Timber-based construction is becoming more popular. "Timber frame housing has come up a little bit more on the market as a potential alternative, in some cases, to other types of building materials that are more energy intensive. It won't work in all cases, but these are the kinds of things we should be looking at if we have the option," says Heather Marshall, campaigns director for the Toronto Environmental Alliance.

But there are limitations to building with wood. In Ontario, the maximum height for wood buildings, according to the province's Building Code, is six storeys. With concrete, the sky's the limit.

Marshall says recycling and reusing construction material such as concrete is something Toronto and other cities are required to do. "Very energy-intensive materials we use to build our cities, like concrete and asphalt, are overused. When we are rebuilding roads, or demolishing buildings, we need to recycle 100 per cent if possible, all of that material."

Key to reducing concrete's greenhouse gas emissions are changes to the production process. With Portland-limestone, up to 15 per cent of the clinker used to make regular Portland cement is replaced by raw limestone, decreasing CO2 emissions from kiln burning by as much as 10 per cent. Portland-limestone, a product that has been in Canada for a decade, performs as well as Portland cement, experts say.

Other alternatives include alkali-activated concrete, magnesium oxide cement, calcium sulfoaluminate concrete, and carbonate cement derived from calcium silicates.

"It is important to point out a few of the numerous examples where non-Portland cements have been used in concrete structures going back decades, such as alkali-activated concrete in the former Soviet Union and calcium sulfoaluminate concrete in China," says Claire White, associate professor of civil and environmental engineering at Princeton University, who is an expert on the cement industry and its greenhouse gas emissions.

The capture of CO2 in cement manufacturing and subsequent storage and utilization has also been developed but can be costly.

Another alternative is a recently developed system that uses combinations of heated clays with ground limestone. It is an inexpensive and widely available source capable of replacing up to 50 per cent of clinker while maintaining a similar level of performance to existing cements, says a 2016 United Nations-supported study.

But regulatory hurdles or "habit-based" barriers inhibit many in the construction industry - along with federal, provincial and municipal staff responsible for procuring materials for infrastructure projects - from considering alternatives, industry experts say.

Ontario's Ministry of Transportation has been reluctant to adopt Portland-limestone cement in roads, bridges, sidewalks and pavements, says Doug Hooton, a professor in the department of civil engineering at the University of Toronto and research chair in concrete durability and sustainability.

"They are really slow off the mark. Research, including work I've done at U of T, has proven it's just as durable and has the same properties as regular cement," Hooton says.

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"People just trust what they are used to. No one wants to change their favourite brand until they are convinced otherwise," says Adam Auer, vice-president of environment and sustainability for the Cement Association of Canada, which represents cement manufacturers here.

The CEO of the association, Michael McSweeney, says the sector is "passionate" about seeing lower greenhouse gases from cement.

"We are very strong supporters on the fight against climate change. Since 1990, on a voluntary basis, we've reduced 20 per cent of our emissions," McSweeney adds.

Stringer and his citizens group in L'Original are concerned about the CO2 emissions, noise from trucks carrying cement to and fro, dust, odours and large smokestacks that an approval of the plant might bring.

"There is also this visual impact, which is very important. This is an area that is extremely flat, extremely flat farmland. You'd basically have one of the biggest, tallest plants in Canada, jutting out from the countryside, says lawyer Gabriel Poliquin, who represents the community group Action Champlain.

Residents have also protested local cement plants elsewhere. A Colacem plant in Grenville-sur-la-Rouge, Que., was at the centre of a class action suit filed by local residents and landowners who complained about noise, dust particles and traffic. Colacem agreed to settle the lawsuit last year by paying \$1.3 million to complainants plus \$135,000 in legal fees, but denied any misconduct or liability. The company has since sold that plant.

In the L'Original case, Stringer and his Vankleek Hill nature group, along with Nature Canada, Ontario Nature and Nature Quebec, pushed federal Environment Minister Catherine McKenna to launch an environmental impact review.

McKenna turned down the request on April 1. Her decision followed an analysis of any "adverse environmental effects" or related public concerns of the proposed plant, says Karen Fish, spokesperson for the Impact Assessment Agency of Canada.

The Colacem plant is subject to rigorous federal and provincial legislative and regulatory oversight and would require federal authorizations under the Fisheries Act, as well as provincial authorizations under the Ontario Planning Act, Environmental Protection Act and Ontario Water Resources Act, Fish says, adding these processes will address and adequately manage potential effects of the plant.

The project would also be subject to the proposed federal Greenhouse Gas Pollution Pricing Act, and Colacem's performance on greenhouse gases will be monitored through the federal Greenhouse Gas Reporting Program, Fish adds.

"Any effects on water quality are not likely to extend to the Ottawa River and air quality parameters would meet provincial regulatory standards near the property boundary," McKenna says in her letter.

Nature Canada, one of the groups fighting Colacem, called McKenna's decision "deeply disappointing for Canadians concerned about global climate change and acid rain." McKenna's decision, Nature Canada said in a statement backed by Stringer's Vankleek Hill group, appeared to rely exclusively on public documents from Colacem that said it would make use "to the extent practicable" of pre-heaters and precalciners (the latter burn fuel more efficiently) to reduce greenhouse gas emissions.

McKenna's letter, Nature Canada said, provides "no assurance" that the ministry tested Colacem's claims.

Under federal regulations finalized in June, most heavy industries will be carbon taxed on 20 per cent of a sector's emissions, using a weighted output-based pricing system that considers "average emissions intensity." But the cement industry only pays a fee on five per cent of its emissions.

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Cement makers' CO2 emissions are more a result of chemical reactions in the production of cement rather than the burning of fossil fuels, the government says, adding it's "trickier" to reduce emissions because altering manufacturing processes would be a longer and more complex process.

In addition, the sector faces higher risks of "competitive impacts" and a higher likelihood of companies leaving Canada for countries where regulations and policies aimed at stopping climate change aren't as rigorous, Environment and Climate Change Canada says.

Cement is with us to stay.

The question remains: How do we live with it?

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